

TITLE OF THE INVENTION

PAPER PICK-UP DEVICE OF IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application claims the benefit of Korean Application No. 2002-5225, filed August 31, 2002 and Korean Application No. 2003-35170 filed May 31, 2003, in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

**[0002]** The present invention relates to a device to pick up and transfer paper stacked on a paper feeding cassette of an image forming apparatus such as a printer, a photocopier, and the like, and more particularly, to a paper pick-up device to pick up paper, by changing a position of a pick-up roller according to type and characteristic of the paper.

2. Description of the Related Art

**[0003]** Generally, an image forming apparatus such as a laser printer or a photocopier has a paper feeding cassette which is removably disposed in a body of the image forming apparatus, to stack therein a plurality of sheets of paper, and a paper pick-up device to consecutively pick up the sheets of paper from a paper stack of the paper feeding cassette and transferring the paper sheets to an image forming engine unit.

**[0004]** As shown in FIG. 1, a paper pick-up device of a conventional image forming apparatus includes a paper feeding cassette 3, which stacks therein a plurality of sheets of paper 1 and has a friction resistance plate 2 inclined by a predetermined angle to a contact with leading ends of the paper sheets 1, and a pick-up roller 5 rotatably supported by a free end of a pick-up bracket 4 so as to pick up and transfer the paper sheets 1. Inside the pick-up bracket 4 is disposed a gear train 6 to transmit a driving force from a driving source (not shown) to the pick-up roller 5.

**[0005]** In such a paper pick-up device for the general image forming apparatus, as the paper feeding cassette 3 is mounted in the body of the image forming apparatus with the paper sheets 1 stacked therein, the pick-up roller 5 disposed above the paper feeding cassette 3 comes into

contact with a topmost one of the paper sheets 1 stacked in the paper feeding cassette 3 as shown in FIG. 1. When the driving source is driven by a controller (not shown) during a printing and the driving force of the driving source is transmitted to the pick-up roller 5 through the gear train 6, the pick-up roller 5 is rotated and thus there occurs a friction between the pickup roller and the paper sheet, thereby picking up the topmost sheet. The paper sheets are picked up one by one due to the presence of the friction resistance plate 2.

**[0006]** However, in the paper pick-up device for the general image forming apparatus with the above-described construction, the pick-up roller 5 comes into contact with the paper sheet 1 at a fixed distance X from the friction resistance plate 2 regardless of paper characteristics such as thickness, surface roughness, and strength. Therefore, in case of printing thin paper which is usually weak in strength, there occurs a multiple-transferring in which plural paper sheets are picked up at one time. Whereas, in a case of using thick paper which is usually great in strength, in a case of using thin paper a paper jam caused by picking up an incorrect number of sheets occurs.

**[0007]** Also, in order to pick up the thick paper without a paper jam, a torque of a driving motor has to continuously increase, thereby causing the problems of power consumption and increased noise .

## SUMMARY OF THE INVENTION

**[0008]** The present invention has been developed in order to solve the above problems in the related art. Accordingly, an aspect of the present invention provides a paper pick-up device of an image forming apparatus, capable of picking up paper, by changing a picking-up position according to paper characteristics set by a printing command, such as thickness, strength, and the like, thereby providing stable paper pick up with respect to every type of paper.

**[0009]** Another aspect of the present invention provides a paper pick-up device of an image forming apparatus, capable of constantly controlling a pick-up force by properly changing a pick-up position of a pick-up roller according to thickness and/or strength of paper, thereby reducing power consumption and noise.

**[0010]** The above and/or other aspects are achieved by providing a paper pick-up device of an image forming apparatus, comprising a paper feeding cassette of a plurality of sheets of

paper, the paper feeding cassette having a friction resistance plate inclined by a predetermined angle to come into contact with a leading end of the paper sheet, the friction resistance plate to separate the paper sheets one by one, a pick-up roller to rotate in contact with a topmost paper of the paper feeding cassette, and to convey the topmost paper toward the friction resistance plate, a pick-up bracket to rotationally support the pick-up roller, and having a gear train to transmit a rotational driving force to the pick-up roller, and pick-up position varying unit to move the pick-up roller to one position among at least two positions which are pre-set in accordance with the paper characteristics.

**[0011]** The two pick-up positions comprise a first pick-up position where a distance between the friction resistance plate and the pick-up roller is set to L1 to allow the pick-up roller to pick-up a paper of strength, and a second pick-up position where the distance is set to L2 shorter than L1 for allowing the pick-up roller to pick-up a paper of low strength.

**[0012]** The pick-up position varying unit comprises a rotary member connected to the pick-up bracket by a shaft to rotate about the shaft, the rotary member having a pair of the pick-up rollers rotatably disposed on an end thereof, a driving unit to rotationally drive the rotary member to move the pick-up roller between the first and the second pick-up positions, and a control unit to detect the paper characteristics and control the driving unit based on the detected paper characteristics.

**[0013]** The driving unit comprises a pair of first link members each having first ends linked with both sides of the rotary member, a pair of second link members each having first ends linked with the second ends of each first link member, which are opposite the first ends of the first link members, by a pin, a shaft fixed to second ends of the second link members, which are opposite the first ends of the second link members, a third link member having a first end fixed to the shaft between the second ends of the second link members, and a driving source connected to the second end of the third link member, which is opposite the first end of the third link member, to link movements of the first, the second and the third link members.

**[0014]** In an embodiment of the invention, the pairs of first link members and second link members may be replaced by a single first link member and a single second link member, respectively.

**[0015]** In an embodiment of the invention, the driving source is a solenoid.

**[0016]** According to another aspect of the present invention, a paper pick-up device of an image forming apparatus, comprises a paper feeding cassette of a plurality of sheets of paper, the paper feeding cassette having a friction resistance plate inclined by a predetermined angle to come into contact with a leading end of the paper sheet, the friction resistance plate to separate the paper sheets one by one, a pick-up roller to rotate in contact with a topmost paper of the paper feeding cassette, and conveying the topmost paper toward the friction resistance plate, a pick-up frame disposed in the paper feeding cassette, a pick-up bracket movably disposed in the pick-up frame, one end of which the pick-up roller is rotatably disposed, and inside of which a gear train is provided to transmit a rotational driving force to the pick-up roller, and a pick-up position varying unit to move the pick-up roller to one among at least two positions which are pre-set in accordance with paper characteristics.

**[0017]** The two pick-up positions comprise a first pick-up position where a distance between the friction resistance plate and the pick-up roller is set to L1 to allow the pick-up roller to pick-up a paper of high strength, and a second pick-up position where the distance is set to L2 shorter than L1 to allow the pick-up roller to pick-up a paper of low strength.

**[0018]** The pick-up position varying unit comprises a conveyance frame reciprocally disposed in the pick-up frame, the conveyance frame supporting a fixed end of the pick-up bracket, a conveyance unit to linearly reciprocate the conveyance frame, and a control unit to detect the paper characteristics and control the conveyance unit based on the detected paper characteristics.

**[0019]** A pair of guide bars outwardly protrude from both sides of the conveyance frame, and a pair of guide grooves are defined in the pick-up frame to receive the pair of guide bars, thereby guiding a movement of the conveyance frame in the pick-up frame.

**[0020]** Also, the conveyance means comprises a rack member provided in the conveyance frame, a pinion engaged with the rack member; and a driving source disposed in the pick-up frame for rotationally driving the pinion.

**[0021]** Additional and/or other aspects and advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]** These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the preferred embodiments taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic side section view showing a paper pick-up device of a conventional image forming apparatus;

FIGS. 2 and 3 are schematic perspective views showing a paper pick-up device of an image forming apparatus according to an embodiment of the present invention;

FIG. 4 is a block diagram showing the paper pick-up device according to the present invention;

FIG. 5 is a side section view showing the paper pick-up device to describe the operation thereof according to the preferred embodiment of the present invention;

FIG. 6 is a perspective view showing an image forming apparatus employing a paper pick-up device according to another embodiment of the present invention;

FIG. 7 is a perspective view showing the paper pick-up device of the image forming apparatus according to another embodiment of the present invention;

FIG. 8 is a side section view showing the paper pick-up device to describe the operation thereof according to another embodiment of the present invention; and

FIG. 9 is a perspective view showing the pick-up bracket of the paper pick-up device for the image forming apparatus according to another embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0023]** Reference will now be made in detail to the present preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

**[0024]** As shown in FIGS. 2 to 5, a paper pick-up device of an image forming apparatus according to an embodiment of the present invention includes a paper feeding cassette 10, a pick-up roller 20, a pick-up bracket 30, and pick-up position varying unit 40.

**[0025]** The paper feeding cassette 10 has a space defined therein in which a plurality of sheets of paper are stacked, and has a friction resistance plate 11 inclined by a predetermined

angle to come into contact with leading ends of the paper sheets. The friction resistance plate 11 causes the paper sheets conveyed by the pick-up roller 20 to be separated sheet by sheet.

**[0026]** The pick-up roller 20 rotates in contact with the topmost paper of the paper feeding cassette 10, thereby transferring the topmost sheet toward the friction resistance plate 11.

**[0027]** The pick-up bracket 30 rotatably supports the pick-up roller 20 and includes a gear train 31 to transmit a rotational driving force from a pick-up driving source (not shown) to the pick-up roller 20.

**[0028]** The pick-up position varying unit 40 moves the pick-up roller 20 to one position among at least two pick-up positions which are pre-set in correspondence with the characteristics of the paper sheets stacked in the paper feeding cassette 10, such as thickness and strength, thereby changing a pick-up position of the pick-up roller 20 suitably to the characteristics of the paper.

**[0029]** FIG. 5 shows the two pick-up positions, i.e., a first pick-up position where a distance between the friction resistance plate 11 and the pick-up roller 20 is set to L1 to allow the pick-up roller 20 to pick up thick paper of high strength, and a second pick-up position where the distance is set to L2 shorter than L1 to allow the pick-up roller 20 to pick up thin paper of low strength. Although this embodiment shows only the first and the second pick-up positions between which the pick-up roller 20 moves variably according to the characteristics such as the thickness and the strength of the paper, there is no limitation, and more pick-up positions can be designated.

**[0030]** The pick-up position varying unit 40 according to the present invention includes a rotary member 50, a driving unit 60, and a control unit 70.

**[0031]** The rotary member 50 is disposed at the pick-up bracket 30 to rotate about an axis 51 to a predetermined angle. A pickup roller shift 52 is included through the rotary member 50. Two pick-up rollers 20 are mounted on both sides of the pick-up roller shaft 52.

**[0032]** The driving unit 60 rotationally drives the rotary member 50 so the pick-up rollers 20 move between the first and the second pick-up positions. The driving unit 60 includes a pair of first link members 61, 61 A each having first ends linked with both sides of the rotary member 50 and extended backward from the rotary member 50, a pair of second link members 63, 63A each having first ends linked with second ends of each of the first link members 61, 61 A, which

are opposite the first ends of the first link members, by a pin 62, 62A, a third link member 65 having a first end fixed to a shaft 64 which is fixed to the second ends of the second link members 63, 63A, which are opposite the first ends of the second link members, and a driving source 66 connected to the other end of the third link member 65, to drive the link movements of the link members 61, 61 A, 63, 63A, and 65.

**[0033]** In another embodiment, a single first link member and a single second link member replace the pairs of first and second link members, respectively.

**[0034]** In the above noted embodiments, the driving source 66 is depicted as a solenoid (FIG. 2). However, this should not be considered a limiting structure. For example, the driving source 66 may be an electromagnet. A frame (not shown) supports the shaft 64 .

**[0035]** As shown in FIG. 4, the control unit 70 detects characteristics of the paper sheets stacked in the paper feeding cassette 10 and controls the driving source 66 based on the detected information. According to an embodiment of the present invention, the paper pick-up device of the image forming apparatus includes a sensor 80 to detect the characteristics, such as thickness and strength, of the paper sheets stacked in the paper feeding cassette 10 . The control unit 70 receives a signal from the sensor 80, determines the characteristics of the paper sheets based on the received signal, and thereby controls the driving of the driving source 66 according to the determined paper characteristics.

**[0036]** Meanwhile, as shown in FIG. 5 the gear train 31 provided in the pick-up bracket 30 is comprised of a plurality of gears, which are interposed between a rotational driving shaft 33, on the one hand, and the pick-up roller shaft 52 disposed through the rotary member 50 on the other hand. The rotational driving shaft 33 penetrates through the pick-up bracket 30 at an opposite side to the position of the rotary member 50. Also, a pick-up gear 32 is mounted on the rotational driving shaft 33. Accordingly, a driving force generated at a pick-up driving source (not shown) is transmitted to the rotational driving shaft 33 through the pick-up gear 32 and then to the pick-up roller shaft 52 through the gear train 31, to thereby rotate the pick-up roller 20.

**[0037]** Referring to FIG. 4, when a printing command is input by a user, the paper pick-up device of the image forming apparatus, according to an embodiment of the present invention, detects characteristics of the paper sheets stacked in the paper feeding cassette 10 by the sensor 80, and transmits the detected paper characteristic information to the control unit 70.

The control unit 70 determines a pick-up position of the pick-up roller 20 based on the detected paper characteristic information by referring to pre-stored information and the detected paper characteristic information. Meanwhile, where no sensor 80 is provided in the image forming apparatus, the image forming apparatus may be designed such that a user himself/herself sets a paper type on a printer driver as he/she inputs a printing command. The paper characteristic information is transmitted to the control unit 70 and the control unit 70 accordingly, determines a pick-up position of the pick-up roller 20.

**[0038]** Determining operation of the pick-up position of the pick-up roller 20 according to the paper characteristic will be described below in detail.

**[0039]** In case of general paper, which is usually weak in strength, as shown in FIGS. 2 and 5, the solenoid acting as the driving source 66 is driven in an arrowed direction as shown in FIG. 2 by the control of the control unit 70. By the driving of the solenoid, the third link member 65 rotates about the shaft 64 in a counterclockwise direction, and the second link member 63, 63A rotates about the shaft 64 in a counterclockwise direction in association with the third link member 65. Accordingly, the first link member 61, 61 A connected to the second link member 63, 63A advance in a direction opposite the arrow in FIG. 2. Due to the movement of the first link member 61, 61 A, the rotary member 50 rotates about the axis 51 in a counterclockwise direction so that the pick-up roller 20 supported by the rotary member 50 is positioned at the second pick-up position which is distanced from the friction resistance plate 11 as much as L2. As described above, when the pick-up roller 20 is positioned at the second pick-up position to thus narrow a gap between the friction resistance plate 11 and the pick-up roller 20, strength of the paper per a length of the paper is increased. Thus, a resistance force at the friction resistance plate 11 becomes as much as is obtained when the thick paper is picked up. Accordingly, the paper sheets are picked up without multiple transferring.

**[0040]** Meanwhile, in case that the paper is of high strength, as shown in FIGS. 3 and 5, the solenoid acting as the driving source 66 is driven in an arrowed direction as shown in FIG. 3. Then, the third link member 65 rotates about the shaft 64 in a clockwise direction, and the second link member 63, 63A rotates in association with the third link member 65 about the shaft 64 in a clockwise direction. Accordingly, the first link member 61, 61 A connected to the second link member 63, 63A retreats. Due to the movements of the first link member 61, 61 A, the rotary member 50 rotates about the axis 51 in a clockwise direction so that the pick-up roller 20



supported by the rotary member 50 is positioned at the first pick-up position distanced from the friction resistance plate 11 as much as L1. As described above, when the pick-up roller 20 is positioned at the first pick-up position to thus broaden a gap between the friction resistance plate 11 and the pick-up roller 20, the strength of the paper per a length of the paper is decreased. Thus, a resistance force at the friction resistance plate 11 becomes as much as is obtained when thin paper is picked-up. That is, with the same degree of the pick-up driving force, the thick paper can be picked up.

**[0041]** When the pick-up position of the pick-up roller 20 is properly determined according to the thickness and the strength of the paper, a driving force is transmitted from the pickup driving source (not shown) to the pick-up roller 20 via the pick-up gear 32, a rotational driving shaft 33, and the gear train 31 to thus rotate the pick-up roller 20. Then, due to the friction occurring between the rotating pick-up roller and the paper, the topmost sheet is picked up and is conveyed to the friction resistance plate 11 and the sheet is separated from the next paper by the friction resistance plate 11.

**[0042]** In another embodiment of the invention, the second and third link members are combined to form a single feature (not shown) that pivots around a central point when the driving source 66 is driven.

**[0043]** FIGS. 6 to 9 are views showing a paper pick-up device of an image forming apparatus according to another preferred embodiment of the present invention. Referring to the drawings, a paper pick-up device of an image forming apparatus according to another embodiment of the present invention includes a paper feeding cassette 100, a pick-up roller 200, a pick-up frame 300, a pick-up bracket 400, and a pick-up position varying unit 500.

**[0044]** The paper feeding cassette 100 has a space defined therein to stack a plurality of sheets of paper 1 and a friction resistance plate 110 inclined by a predetermined angle to contact with the leading ends of the paper sheets 1. The friction resistance plate 110 separates the paper conveyed by the pick-up roller 200 sheet by sheet.

**[0045]** The paper feeding cassette 100 is removably mounted in a cassette mounting portion 610 provided in a body 600 of the image forming apparatus.

**[0046]** The pick-up roller 200 rotates in contact with a topmost sheet of the paper sheets 1 stacked on the paper feeding cassette 100 and conveys the topmost sheet toward the friction resistance plate 110.

**[0047]** The pick-up roller 200 is rotatably disposed at an end of the pick-up bracket 400. The pick-up bracket 400 is provided with a gear train 420, as shown in FIG. 8, to transmit a driving force of a first driving motor 410 to the pick-up roller 200.

**[0048]** The pick-up bracket 400 is movably disposed at the pick-up frame 300.

**[0049]** The pick-up position varying unit 500 moves the pick-up bracket 400 in order for the pick-up roller 200 to be positioned at one position among at least two pick-up positions which are pre-set in correspondence with the characteristics of the paper.

**[0050]** The two pick-up positions include a first pick-up position where a distance between the friction resistance plate 110 and the pick-up roller 200 is set to L1 to allow the pick-up roller 200 to pick up the thick paper of high strength, and a second pick-up position where the distance is set to L2 shorter than the L1 to allow the pick-up roller 200 to pick up the thin paper of low strength.

**[0051]** The pick-up position varying unit 500 includes a conveyance frame 510, conveyance unit 520, and a control unit 70 (see FIG. 4).

**[0052]** The conveyance frame 510 supports a fixed end of the pick-up bracket 400 and is reciprocally disposed at the pick-up frame 300.

**[0053]** A pair of guide bars 511, 512 outwardly protrude from both sides of the conveyance frame 510, and a pair of guide grooves 311, 312 are defined in the pick-up frame 300 to receive the pair of guide bars 511, 512, thereby guiding the movement of the conveyance frame 510 in the pick-up frame 300. The first guide bar 511 is connected to both of the fixed ends of the pick-up bracket 400 and the conveyance frame 510. Accordingly, the pick-up bracket 400 reciprocates in response to the position of the first guide bar 511 to a predetermined angle and thus the pick-up roller 200 disposed at one end of the pick-up bracket 400 comes into contact with the topmost sheet stacked on the paper feeding cassette 100.

**[0054]** The conveyance unit 520 allows the conveyance frame 510 to reciprocate in the pick-up frame 300. The conveyance unit includes a rack member 521 disposed on the conveyance frame 510, a pinion 522 engaged with the rack member 521, and a second driving motor 523 disposed in the pick-up frame 300 to rotationally drive the pinion 522.

**[0055]** The control unit 70 performs the same operation as that of the above-described embodiment. That is, the control unit 70 detects characteristics of the paper and controls the driving of the second driving motor 523 of the conveyance unit 520 based on the detected paper characteristic information. As in the above-described embodiment, the paper pick-up device of the image forming apparatus includes a sensor 80 to detect characteristics of the paper such as thickness and strength according to a paper type, so that the control unit 70 receives a signal from the sensor 80, determines the characteristic of the paper according to the paper type, and accordingly controls the second driving motor 523 based on the determined characteristics.

**[0056]** Hereinafter, operations of the paper pick-up device for the image forming apparatus according to another embodiment of the present invention will be described with reference to FIGS. 4, 8, and 9.

**[0057]** The basic operations are performed in the same way as in the above-described embodiment.

**[0058]** That is, when a printing command is input, the sensor 80 detects the characteristic information of the paper stacked in the paper feeding cassette 100 and transmits the information to the control unit 70. The control unit 70 determines a pick-up position of the pick-up roller 200 based on the detected paper characteristic information, and then controls the second driving motor 523 so the pick-up roller 200 is moved to the determined pick-up position.

**[0059]** That is, in case of thin paper of low strength, the second driving motor 523 is rotationally driven in a clockwise direction in order for the pick-up roller 200 to pick-up the paper at the second pick-up position L2. Then, the conveyance frame 510 is moved to the left-hand side of the drawings by the pinion 522 and the rack member 521 and the pick-up bracket 400 connected to the conveyance frame 510 is accordingly moved, so that the pick-up roller 200 is positioned at the second pick-up position. At this position, a driving force of the first driving motor 410 is transmitted to the pick-up roller 200 through the gear train 420 to rotate the pick-up roller 200. Due to the rotation of the pick-up roller 200, there occurs a friction between the pick-

up roller 200 and the paper, and due to the friction, the topmost paper sheet alone is picked up and conveyed toward the friction resistance plate 110. As described above, when the pick-up roller 200 is positioned at the second pick-up position to thus narrow a distance between the friction resistance plate 110 and the pick-up roller 200, the strength per a length of the paper becomes high. Accordingly, since there occurs a resistance force at the friction resistance plate 110 as that occurring of the resistance force when thick paper is picked-up, the paper is picked-up without multiple transferring.

**[0060]** Meanwhile, in case of thick paper, the second driving motor 523 is rotationally driven in a counterclockwise direction so the pick-up roller 200 picks-up the paper at the first pick-up position L1. Then, the pick-up bracket 400 is moved to the right-hand side of the drawings, which is opposite to the thin paper case, so that the pick-up roller 200 is changed from the second pick-up position L2 to the first pick-up position L1. As described above, when the pick-up roller 200 is positioned at the first pick-up position to thus broaden the distance between the friction resistance plate 110 and the pick-up roller, the strength per the length of the paper becomes low. Thus, since there occurs a resistance force at the friction resistance plate 110 as of the resistance force when thin paper is picked-up, the thick paper is picked up with the same level of the pick-up force that picks up the thin paper.

**[0061]** According to the present invention as described above, the pick-up device of the image forming apparatus picks up the paper sheets with a variably changing pick-up position in accordance with the characteristic, such as thickness and surface roughness, of the paper, thereby preventing paper slip, multiple transferring, and paper jam during the conveyance of the paper. Accordingly, there is an advantage of having precise paper picking-up and conveying operations.

**[0062]** Also, since a pick-up force is variable controlled by changing the pick-up position according to the characteristic of the paper, power consumption and noise can be reduced.

**[0063]** Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.